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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 10/789,588 | 02/27/2004 | Andrew M. Dattelbaum | S-100,636 | 7785 |

35068 7590 07/25/2007
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| EXAMINER |
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SODERQUIST, ARLEN

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| ART UNIT | PAPER NUMBER |
|----------|--------------|

1743

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| MAIL DATE | DELIVERY MODE |
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07/25/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/789,588

Applicant(s)

DATTELBAUM ET AL.

Examiner

Arlen Soderquist

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 April 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-17 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

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1. Claim 11 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 11 is dependent upon itself. It is noted that claim 11 was supposedly amended, but examiner cannot find any change from the original claim 11.

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 1, 4-7 and 9-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xi in view of Garcia-Macedo (SPIE 2002, newly cited and applied). In the paper Xi presents spectroscopic studies on conjugated polymers in mesoporous channels. The influence of mesoporous environment on the conjugated polymers was studied by UV-Vis absorption and Photoluminescence spectroscopy (detector). The applied polymers were three novel poly(p-phenylenevinylene) derivatives (DDMA-PPV) shown in figure 1. These polymers have dibenzothiophen-5,5-dioxide units in their backbones, but are different from each other in the length of alkoxy side-chains. The polymers were incorporated into the mesoporous channels of SBA-15 by sorption from their dilute solutions. The confined polymers exhibited different trends in the shifts of the absorption onsets and the emission peaks depending on the length of the side-chains. The polymer with shorter side-chain showed red-shifts in both the absorption and emission spectra, whereas the polymer with longer side-chain showed blue-shifts. These phenomena were caused by the combined influences from the electronic confinement and the conformation distortion. Moreover, these trends were enhanced when the polymers were loaded

in amine-modified SBA-15. The synthesis of the mesoporous silica materials is taught in the experimental section and used an amphiphilic block copolymer under acidic conditions. In the first paragraph of the introduction of page 2451 the properties of host–guest materials are discussed as showing many interesting properties due to their specific intermolecular interactions and the ‘boxing effect’. The hosts, such as zeolites and mesoporous materials, possess nano-periodic and size-tunable cages or channels which can act as versatile templates for preparing guests with diameter from several angstroms to hundred nanometers. Such nano-sized guests, especially semiconductors, exhibit some special properties due to the quantum-size effects. Moreover, the ordered and oriented guests may show magnetic or charge transport properties different from their bulk phase. It is interesting to study the interactions between hosts and guests, since the large interfacial area and confined environment may enhance the intermolecular forces, leading to significant changes in the molecular properties of embedded guests, and these changes may provide valuable information for catalysis, optical and electrical applications. Xi does not teach the material formed as a film.

In the paper Garcia-Macedo discusses charge transport under illumination in mesoporous continuous films. Recent developments in the preparation of surfactant-templated mesostructured sol-gel silica materials have extended the morphology from the originally discovered powders, with particle sizes on the order of microns, to mesoporous continuous thin films. These films could find applications in membrane-based separations, selective catalysis and sensors. The interest in the potential applications of these films and the introduction of new properties lead to the research of their chemical modifications. The improvement of their photorefractive response requires knowledge of the microscopic processes, such as the charge transport mechanism. The photoconductivity technique provides information about that mechanism, and it allows for measuring the transport parameters. Mesoporous continuous films were prepared by the dip-coating method on glass substrates. The films were doped with SDS, carbazole (SiK) and dispersed red one (DR1) at 1:20:20 M concentration. Photoconductivity studies were done on them at different illumination wavelengths in order to know the transport mechanism and surfactant influence. In the last full paragraph of page 137, polymer chains are taught as being expected to line up in layered structures when incorporated into the films

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potentially allowing electron transport through the film. The experimental section teaches optical absorption of the films.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the Xi material as a film as taught by Garcia-Macedo because of the ability to measure the properties in the form of a film as taught by Garcia-Macedo and evaluate it for properties beneficial to potential applications as taught by Xi for powders and as taught by Garcia-Macedo in film form as an advance over the powders of the prior art.

4. Claims 1-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hernandez in view of Zhao. In the paper Hernandez teaches the controlled placement of luminescent polymers in mesostructured sol-gel thin films. Three 1-step methods to design hybrid mesoporous SiO₂ thin films in which the desired molecule is deliberately placed in a specified region of the mesostructure were demonstrated. These methods are improvements on methods that form the mesoporous structure first followed by diffusion of the dopant into empty pores. The 2nd approach utilizes an organic conducting polymer containing sulfonate groups (i.e., water-soluble poly((2,5-methoxypropyloxysulfonate)phenylene vinylene)), which is dissolved in the initial sol, and, as the film is formed, the organic backbone is incorporated in the organic region of the film while the sulfonate groups reside in the ionic interface region. In this process the polymer is added to a solution containing the sol gel forming precursors and the cationic template cetyltrimethylammonium bromide (CTAB, see footnote 31). Figure 2 and its associated discussion teach the detection of polarized fluorescence from the material. Hernandez does not teach the use of a non-cationic surfactant in the formation of the mesoporous structure.

In the paper Zhao teaches a family of highly ordered mesoporous (20-300 Å) silica structures synthesized by the use of commercially available nonionic alkyl poly(ethylene oxide) (PEO) oligomeric surfactants and poly(alkylene oxide) block copolymers in acid media. Periodic arrangements of mesoscopically ordered pores with cubic Imm, cubic Pmm (or others), 3-d hexagonal (P6₃/mmc), 2-d hexagonal (p6mm), and lamellar (L) symmetries have been prepared. Under acidic conditions at room temperature, the nonionic oligomeric surfactants frequently form cubic or 3-d hexagonal mesoporous silica structures, while the nonionic triblock copolymers tend to form hexagonal (p6mm) mesoporous silica structures. Hexagonal mesoporous silica structures with d(100) spacings of 64-77 Å can be synthesized at 100 C by

using oligomeric nonionic surfactants. Highly ordered hexagonal mesoporous silica structures (SBA-15) with unusually large $d(100)$ spacings of 104-320 Å have been synthesized in the presence of triblock poly(ethylene oxide)-poly(propylene oxide)-poly(ethylene oxide) (PEO-PPO-PEO) copolymers. The EO/PO ratio of the copolymers can be used to control the formation of the silica mesophase: lowering this ratio of the triblock copolymer moieties promotes the formation of lamellar mesostructured silica, while higher ratios favor cubic mesostructured silica. The assembly of the inorganic and organic periodic composite materials appears to take place by a hydrogen bonding ($\text{Si-OH}^+(\text{X-I}^-)$) pathway. Page 6025 teaches that the overall strategy of using block copolymers in materials synthesis is applicable not only to composites containing hydrophilic-hydrophobic copolymers, such as the silica-poly(alkylene oxide) system, but more generally to any self-assembling surfactant or copolymer system in which a network-forming additive is selectively partitioned among different mesostructured components. An enormous variety of nanophase-separated composite materials can be envisioned in which variations in the choice of blocks, copolymer compositions, solvents, or chain architecture are used to tune self-assembly, while processing variables such as temperature, pH, aligning fields, etc., are manipulated to regulate fixation of the resultant structure(s). For several reasons, including product cost, environmental, and biomimetic considerations, they sought to use dilute aqueous organic concentrations in silica composite and mesoporous materials syntheses. Built into this has been the idea of cooperative self-assembly of the molecular inorganic and organic species, which together influence the final morphology and mesoscopic ordering obtained and both of which can be controlled kinetically and via inorganic-organic interface interactions. Balanced Coulombic, hydrogen bonding, and van der Waals interactions with charge matching in aqueous syntheses provide an effective means of enhancing long-range periodic order. Such interactions are particularly important at the inorganic-organic interface and can be realized by working with cationic silica species below the aqueous isoelectric point of silica (pH \sim 2). With cationic surfactants and syntheses carried out in HCl media below the aqueous isoelectric point of silica, the key interactions are among the cationic surfactant, chloride anion, and the cationic silica species (designated as $\text{S}^+\text{X-I}^-$, where S^+ is the cationic surfactant, X^- is the halide anion, and I^+ is a protonated Si-OH moiety, i.e., $[\text{Si}]^+$, and the overall charge balance is provided by association with an additional halide anion). Solubilization of nonionic poly(alkylene oxide)

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surfactants and block copolymers in aqueous media is due to the association of water molecules with the alkylene oxide moieties through hydrogen bonding. This should be enhanced in acid media where hydronium ions, instead of water molecules, are associated with the alkylene oxygen atoms, thus adding long-range Coulombic interactions to the coassembly process (see especially the last two full paragraphs of page 6025). If carried out below the aqueous isoelectric point of silica, cationic silica species will be present as precursors, and the assembly might be expected to proceed through an intermediate of the form $(\text{SiOH}^+)(\text{X-I}^-)$. The anion may be coordinated directly to the silicon atom through expansion of the silicon atom's coordination sphere. The goal was to use this structure-directing route to create highly ordered structures with low-cost, nontoxic, and biodegradable nonionic organics under relatively dilute aqueous conditions. In particular, they chose to investigate the use of block copolymers in order to extend the range and control of inorganic-organic mesophase structures from nanometer to larger length scales. The last full paragraph of 6027 teaches that one mesoporous material synthesized with a non-ionic surfactant is similar to another material in which the cationic alkyl ammonium group was present. The first paragraph of page 6028 teaches that the non-ionic surfactant is removed during calcinations at a lower temperature than the cationic CTBA surfactant.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a non-ionic block copolymer in the Hernandez process of forming the mesoporous materials because of the advantages related to ability to tune the structure based on the surfactant structure, cost of the materials, ability to remove the surfactant at a lower temperature and the similarity to the cationic surfactant formation process and the surfactant solubilization advantage when using non-ionic surfactants in the process in an acidic environment as taught by Zhao at least on pages 6025 and 6027-6028.

5. Claims 13-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hernandez in view of Zhao as applied to claim 1-12 above, and further in view of Chen. Hernandez does not teach the use of the materials to sense nitroaromatics.

In the paper Chen discusses the application of poly((2,5-methoxypropyloxysulfonate)phenylene vinylene) for chemical sensing. Both the photophysics and the fluorescence quenching behavior of the anionic conjugated polymer towards various small molecule quenchers can be modulated effectively by complexing the polymer with a

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simple counter-charged detergent. For example upon adding dodecyltrimethylammonium bromide (DTA) to the polymer, cationic quenchers such as Me viologen become less effective while the quenching by neutral reagents - most notably nitroaromatics or cyanoaromatics - is enhanced. Page 28 teaches that the enhancement is due to the hydrophobic environment created by the surfactant around the polymer acting to chaperone the nitroaromatics into association with the polymer. Thus, the polymer-detergent complex provides a new platform for sensing chemical agents via fluorescence quenching. Thin films formed from the complex exhibit high sensitivity to quenching by nitroaromatic vapor (TNT and DNT, figures 3 and 5) and reasonable reversibility (line A compared to line C).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the Hernandez material as a sensing material for nitroaromatics because of the use of the polymer in the presence of a surfactant as taught by Chen.

6. Applicant's arguments filed April 30, 2007 have been fully considered but they are not persuasive. Relative to the rejection by the Xi reference, the arguments are moot because of the new grounds of rejection by addition of the newly cited and applied Garcia-Macedo reference and changing the rejection to an obviousness rejection. Relative to the rejection based on the Hernandez reference examiner notes that there are ample comparisons between structures formed using a cationic surfactant and those using the non-ionic surfactant taught by Zhao. In these comparisons the structures formed using the non-ionic surfactants are taught as similar to those formed using cationic surfactants. Additionally there are clear advantages such as removal of the non-ionic surfactant at a lower temperature than the known cationic surfactants during calcinations, ability to modify the structure easily by changing the synthesis components and/or conditions and the cost of the surfactant materials. Thus there is a clear motivation to substitute the non-ionic surfactants of Zhao for the cationic surfactants of Hernandez. Relative to claims 13-17 the arguments are not commensurate on scope with the claims. First Hernandez clearly teaches that the dopants are found through the pore structure. Second, the instant application does not show that the nitroaromatics are diffusing deeply into the porous structure. Thus the quenching seen could be due to molecules located at the pore ends. Additionally the Chen reference clearly teaches the ability of the detergent to chaperone the nitroaromatics into association with the polymer. Thus, the polymer-detergent complex provides a new platform for

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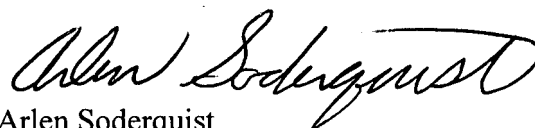
sensing chemical agents via fluorescence quenching. The figures of Chen also show reasonable reversibility since line A is before exposure and line C is after exposure to the nitroaromatic compound and a vacuum treatment. It is clear that the vacuum treatment brings the spectrum line C, to essentially the pre-exposure spectral line A.

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The additional art is related to mesoporous sol-gel layers.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Arlen Soderquist whose telephone number is (571) 272-1265. The examiner can normally be reached on Monday-Thursday and Alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jill Warden can be reached on (571) 272-1267. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



Arlen Soderquist
Primary Examiner
Art Unit 1743